ADAPTIVE BATTERY PROTECTION

[0001] The subject matter described herein relates to protecting a battery-powered device from over-current conditions that could cause damage to the battery-powered device or injury to a user of the device.

BACKGROUND

[0002] Many modern electronic devices are battery powered. Mobile devices are almost always battery-powered including a wide variety of consumer and industrial products, such as cell phones, handheld computing devices, laptops, and many other portable devices. As the features available in portable devices have increased, the power consumption of these devices has also increased. Increased power consumption has led to the possibility of overheating, which could result in damage to the device or injury to the user. For example, a hand-held cellular telephone that overheats could destroy the phone and/or injure the user's hand or face. Moreover, the increased complexity and capability of these devices has caused the normal power consumption to increase to a level where if the same amount of power were consumed due to a hardware or software failure, overheating could result and the overheating could cause injury.

SUMMARY

[0003] Methods and apparatuses, including computer program code are disclosed herein that provide adaptive battery protection.

[0004] In one aspect, there is provided a method. The method includes disabling a timer, when a current drawn by a battery-powered device from a battery is less than or equal to a lower current threshold. When the timer is disabled, the battery may remain connected to the battery-powered device. The method further includes enabling the timer when the current drawn from the battery is greater than the lower current threshold and less than an extended current threshold. When the timer is enabled, the timer may allow the battery to remain connected to the battery-powered device until the timer expires. The method further includes disconnecting the battery when the timer expires or when the current drawn from the battery exceeds the extended current threshold.

[0005] In some variations, one or more of the features disclosed herein including the following features can optionally be included in any feasible combination. The method may further include enabling the timer, when the current drawn from the battery is greater than the lower current threshold and less than a normal current threshold, wherein the enabled timer allows the battery to remain connected until the timer expires; and disconnecting the battery, when the timer expires or the current drawn from the battery exceeds the normal current threshold. The method may further include resetting the timer to prevent the expiration of the timer based on a first received indication. The first received indication may represent use of an apparatus drawing current from the battery. The timer may be disabled based on a second received indication.

[0006] In another aspect, there is provided a method. The method may include determining to send at least one reset signal comprising instructions to reset a timer at a battery pack.

[0007] In some variations, one or more of the features disclosed herein including the following features can optionally be included in any feasible combination. The method may further include determining to send at least one enable signal

comprising instructions to enable the timer at the battery pack. The determining to send the at least one reset signal or determining to send the at least one enable signal may further include determining whether the battery pack supports an extended current mode or a normal current mode. The at least one enable signal or the at least one reset signal may be sent if the battery pack supports the extended current mode. The least one reset signal may be sent periodically.

[0008] The above-noted aspects and features may be implemented in systems, apparatuses, methods, and/or computer-readable media depending on the desired configuration. The details of one or more variations of the subject matter described herein are set forth in the accompanying drawings and the description below. Features and advantages of the subject matter described herein will be apparent from the description and drawings, and from the claims. In some exemplary embodiments, one of more variations may be made as well as described in the detailed description below and/or as described in the following features.

DESCRIPTION OF DRAWINGS

[0009] In the drawings,

[0010] FIG. 1 depicts an example of a battery-powered device, in accordance with some example embodiments;

[0011] FIG. 2 depicts a schematic diagram of an apparatus for protecting battery-powered devices from over-current conditions, in accordance with some example embodiments;

[0012] FIG. 3 depicts an example plot showing the current drawn by a battery-powered device, in accordance with some example embodiments; and

[0013] FIG. 4 depicts process for protecting battery-powered devices from over-current conditions, in accordance with some example embodiments.

[0014] Like labels are used to refer to same or similar items in the drawings.

DETAILED DESCRIPTION

[0015] The current available from many modern batteries is sufficient to cause damage to plastic components, injury to a user, or damage to the environment if a failure occurs that allows excessive current and/or overheating. For example, a short-circuit in a battery-powered mobile device could cause plastic components to melt, damage to the overheating electronic components, and in the worst case, a fire. Embodiments consistent with the subject matter disclosed herein may allow high current levels to be drawn from a battery in a battery-powered device while protecting the device from over current conditions that could cause damage or injury. Battery-powered devices (also referred to herein as a devices or battery-powered apparatuses) utilizing the subject matter disclosed herein may include a wide range of consumer and industrial devices, such as cellular telephones, smart phones, personal digital assistants (PDAs), netbooks, notebook computers, laptop computers, custom designed computing devices, industrial control devices, remote sensing devices, and any other battery-powered device.

[0016] FIG. 1 illustrates a block diagram of an example of a battery-powered apparatus 10, in accordance with some embodiments. FIG. 1 depicts a battery-powered apparatus 10 comprising a user equipment, such as a cellular telephone, a smartphone, and the like.

[0017] In some example embodiments, the apparatus 10 may include battery protection circuit 103 coupled or capable